MEASURING INTELLIGIBILITY IN CHILDREN: WHY AND HOW

Peter Flipsen Jr., PhD, S-LP(C), CCC-SLP
Idaho State University
flippete@isu.edu

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INTELLIGIBILITY
• Making yourself understood.
• The ultimate goal of human communication.
• Usually the long-term goal for most clients we work with.

IF IT’S THE GOAL, LET’S MEASURE IT!
• Measure it at baseline to know where we start.
• Measure it regularly to monitor progress.

INTELLIGIBILITY AND ACCURACY
• Related but NOT THE SAME THING.
• Typically-developing 4 year old is fully intelligible (100%).
  • But still makes some speech sound errors.
• Many children with SSD present with much reduced intelligibility.
  • But they may have enough sounds correct in single words that they DON’T qualify for services.

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BEING INTELLIGIBLE
• Means:
  • Choosing the best words to convey intentions
  • Formulating the syntax correctly
  • Knowing the correct sounds to produce
  • Including the appropriate prosody
  • Staying on topic
  • Having the physical skill to produce the entire message fluently.

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INTELLIGIBILITY
• More than just speech sound accuracy!
• Can NOT be adequately measured with an articulation test!
  • Ertmer (2010) and others have shown that single word artic scores rarely account for more than 25% of the variability.

• Need to measure it directly by asking:
  • “how much can be understood?”

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MEASURING INTELLIGIBILITY
• If you want to know how well someone is being understood.

YOU HAVE TO MEASURE HOW MUCH IS BEING UNDERSTOOD!
MEASURING INTELLIGIBILITY

- How do we do it?
- Many clinicians make informal estimates.
- Demo.

INFORMAL ESTIMATES?

- Probably no better than pulling numbers out of a hat.
- Highly variable across listeners.
- Rely on memory.
- Not valid for monitoring progress as SLP becomes a “more familiar listener”:
  - Calibration changes over time.

RATING SCALES – AN ALTERNATIVE?

- Many available. For example:
  1. completely intelligible
  2. mostly intelligible
  3. somewhat intelligible
  4. mostly unintelligible
  5. completely unintelligible

- Schiavetti (1992) identified several problems:
  1. listeners don’t treat all parts of the scale equally.
  2. high variability in scores across listeners especially in the middle of the scale.
  3. they don’t allow us to identify possible sources of intelligibility breakdowns.

RATING SCALES – PRACTICAL PROBLEMS

- 1. How much change does it take to move from one level to the next?
  - Not clear.
  - Not consistent across points on the scale.

- 2. Such scales are NOT sensitive enough to track change in individuals over time.

WRITE-DOWN PROCEDURES

- Generally considered the best approach.
- Listener tries to identify exactly what the intended message was.
- We calculate actual % understood.

WRITE-DOWN PROCEDURES

- Possible at several linguistic levels.

  1. Single words.
     - Spontaneous or imitated.
  2. Sentences.
     - Spontaneous or imitated.
  3. Conversation.
**Write-down Procedures**

- Which level to use?

- Speakers with less than perfect speech likely to perform differently at different levels.
  - Milder cases do better in connected speech because context helps listener to “fill in the blanks”.
  - More severe cases do better in single words because high level of errors overwhelm the listener.

- Ideally do more than one level.

**Single Word Procedures**

- Several possible approaches.

- Most flexible procedure available is:
  - Children’s Speech Intelligibility Measure (CSIM)
    - By Wilcox and Morris
    - Published by Psych Corp in 1999.

**CSIM**

- 50 item test.
- NOT norm-referenced.
- Can be administered multiple times because unique test is created each time.
  - Each item has 12 “similar sounding” words.
    - E.g., tall, stall, wall, shawl, call, all, fall, ball, crawl, mall, Paul
    - E.g., Tanner, planner, matter, manner, mother, banner, mother, brother, sander, bother, batter, other

- Pick 1 item at random before administering.
  - Child imitates examiner saying the word (can read it if they are old enough).
  - Record child’s productions and give to unfamiliar listeners (preferably at least 2).
    - Listener either writes word down with no reference or circles word on blank test form (multiple choice option).

**Sentence Level Procedures**

- Several possible have been proposed.

- For very young or very unintelligible children one quite flexible one is:
  - The Beginner’s Intelligibility Test (BIT).
    - Originally designed for the hearing impaired but can be used with any population


- NOT norm-referenced.
- 4 sets of 2-5 word sentences.

- E.g.,
  1. The bear sleeps.
  2. Mommy sits.
  3. The rabbit hops.
  4. The cowboy jumps.
  5. Grandma falls.
  6. That is a black hat.
  7. The boy is under the table.
  8. My airplane is small.
  9. He is painting the chair.
  10. She is cooking dinner.
BIT

- Use one set each time so it can be administered at regular intervals.
- Child imitates or reads the sentences which are recorded.
- Give recording to 2 unfamiliar listeners who write down what they hear.
- Calculate % of words correctly identified.

FOR OLDER CHILDREN (7 YEARS+)

- Could use sentence portion of:
  - Assessment of the Intelligibility of Dysarthric Speech.
    - By Yorkston & Beukelman. Published by Pro-Ed.
    - NOT norm-referenced.
    - Select 5 sentences from each list of 5-8 word sentences (20 total sentences, 130 total words).
    - Child imitates or reads the sentences which are recorded.
    - Give recording to 2 unfamiliar listeners who write down what they hear.
    - Calculate % of words correctly identified.

CONVERSATION

- Most ecologically valid approach (i.e., this is what we do most of the time).
  - Record true interaction.
  - Avoid narratives as they may induce abnormal prosody which may influence scores.
  - Have unfamiliar listeners transcribe what they hear (regular spelling!).
  - % understood = words understood
  - -------------------------
  - (words understood + words not understood)

CONVERSATION – BIG CHALLENGE

- Unlike CSIM or BIT we won’t know what the intended targets are.
- How many words are present in the parts we don’t understand?
  - With occasional unintelligible parts, listeners can easily guess how many words are there.
  - They use context to help.

- With longer stretches no context to help.
- Listeners can count syllables!
  - Each syllable contains a vowel and vowels are louder.
  - Have them put X down for each syllable heard.
- Use the syllable counts to estimate the number of unknown words.
  - For most young children about 75% of words are 1 syllable long. Most of the rest are 2 syllables long.
  - 3:1 ratio = 1.25 syllables per word on average.
  - Count syllables heard. Divide by 1.25 to get words not understood.

WHO SHOULD BE JUDGES?

- Unfamiliar = best test.
  - Don’t do it yourself because you will become familiar very quickly (and biased!).
- Preferably use inexperienced listeners but use colleagues who don’t know the child if necessary.
  - Do it for each other to spread the work around.
WHO SHOULD BE JUDGES?

- Don’t use parents or siblings.
  - Tend to be highly familiar so you get over-estimate of intelligibility.


CLINICAL DECISIONS: HOW INTELLIGIBLE? WHAT CRITERIA?

- No known valid norms available.
  - Too many variables involved to develop such norms.

- Best index =
  - age in years / 4 = % understood in conversation.

- 2 years old = 2/4 or 50% 
- 3 years old = 3/4 or 75%
- 4 years old = 4/4 or 100% *

- * speech sound errors still quite possible.